**BUREAU OF ENVIRONMENTAL REMEDIATION/REMEDIAL SECTION POLICY**

# GUIDELINES FOR RANKING CONTAMINATED SITES

**BER POLICY # BER-RS-001**
**DATE: 1991**
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This guide describes the Contaminated Sites Ranking System (CSRS) to be used in evaluating contaminated sites in Kansas. The purpose of CSRS is to set priorities for cleaning up contaminated sites where a responsible and/or voluntary party has not been identified, or has been identified but is recalcitrant and/or financially unable to address the site. However, the CSRS by itself cannot establish priorities for allocation of limited state funds for remedial action. Uniform application of the ranking system throughout the state will permit KDHE's Bureau of Environmental Remediation to identify those releases of contaminants that pose the greatest hazard to human health and the environment. The CSRS is a means for applying uniform technical judgment regarding the potential hazards presented by one site relative to another site. It does not address the feasibility, desirability or degree of cleanup required, nor does it deal with readiness or ability of the State of Kansas to carry out remedial action as may be indicated.

The score for each pathway (Soil/Bedrock, Ground Water, Surface Water, or Air) is obtained by considering a set of factors that characterize the potential of a contaminated site to impact human health and/or the environment (Table 1). Each factor is assigned a numerical value with variable range according to the guidelines described herein. The factor scores are then combined: Scores within a factor category (Waste Characteristices (W), Physical Characteristics (P), or Targets (T)) are added; then the total scores for each factor category are multiplied together to develop a score for soil/bedrock, ground water, surface water, or air. In computing an individual pathway score, the product of its factor category scores is divided by an appropriate value. The last step puts all scores on a scale of 0 to 100.

The Site Score (S) is a composite of the scores for the four possible pathways:

$$S = (S_1 \times 0.60) + (S_2 \times 0.25) + (S_3 \times 0.10) + S_4 \times 0.05)$$

where:

$S_1$ = Highest Score
$S_2$ = Second Highest Score
$S_3$ = Third Highest Score
$S_4$ = Fourth Highest Score

The effect of combining the pathway scores in this manner is to emphasize the primary (highest scoring) pathway while giving additional consideration to the secondary or tertiary pathways, even if they score relatively low.

EMERGENCY SCORE ($S_E$): Emergency status may be established under <u>any</u> of the following conditions:

1. PWS well or Private Drinking Well is contaminated and no alternate source available, <u>or</u>
2. Surface Drinking Water or Drinking Water Inlet is contaminated and no alternate source available, <u>or</u>
3. A high probability exists for direct contact to contaminated soil and/or waste exists.

## SCORING INSTRUCTIONS

The following sections give detailed instructions and guidelines for ranking a site. Each section gives instructions for evaluating factors for each pathway. Using the guidance provided, assign a score to each of the pathway media which are contaminated above the regulatory limit.

### WASTE CHARACTERISTICS ($S_W$)

#### A. Toxicity of Contaminant(s)

The toxicity of the contaminant(s) at the site should be determined based upon the human health risk associated with the most toxic contaminant identified, or suspected, at the site. The criteria for determining the toxicity classification for all contaminants of concern is based upon EPA toxicological databases including the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST), among others. Contaminants are classifed into two general groups, carcinogens (known, probable and suspected) and non-carcinogens. Based upon the toxicological mechanism of carcinogens, commonly referred to as the "zero tolerance" effect, all carcinogens shall be classified as "Highly Toxic". For the group of non-carcinogenic contaminants, the toxicity classification is determined by the chemical-specific oral or inhalation Reference Dose (RfD), whichever is greater, as provided by IRIS, HEAST, etc. The following table defines how each contaminant is classified for the purpose of this hazard ranking system:

Table 2. Toxicity of Contaminant

| Toxicity of Contaminant | Assigned Value |
|---|---|
| Relatively Non-Toxic | 12 |
| Toxic | 13 |
| Moderately Toxic | 14 |
| Extremely Toxic | 15 |

To determine the appropriate classification of toxicity for the contaminants identified or suspected at the site, please refer to Appednix 1.

#### B. Quantity of Waste

Waste *quantity* includes all contamination (such as hazardous substances, hazardous waste and/or solid waste) at a site. Although detailed disposal records and/or detailed analytical data are necessary to evaluate quantity, this level of information is not often available for a contaminated site. Waste quantity is most commonly evaluated on the basis of volume or area. Using the appropriate size range and appropriate source type, assign a value using the following guidance.

Table 5. "Quantity of Contaminant Released to Ground Water

Matrix: Area vs. Concentration relative to Kansas Action Levels (KAL)

## C. Physical State of Waste

*Physical state* refers to the state of the waste at the time of disposal, except that gases generated by the waste in a disposal area should be considered in rating this factor. Each of the waste types being evaluated is assigned a value as follows:

Table 6. Physical State of Waste

| Physical state | Assigned Value |
|---|---|
| Solid, consolidated or stabilized | 0 |
| Solid, unconsolidated or unstabilized | 1 |
| Powder or fine material | 2 |
| *Liquid, sludge or gas | 3 |

* If ground water is contaminated a default value of 4 is given.

## D. Containment

*Containment* is a measure of the natural or artificial means that have been used to minimize or prevent a contaminant from entering soil/bedrock, ground water or surface water. Examples include: liners, leachate collection systems, and sealed containers. In assigning a value to this rating factor (Table 7 and 8), consider all ways in which wastes are stored or disposed at the site. If the site involves more than one method of storage or disposal, assign the highest from among all applicable values (e.g., if a landfill has a containment value of 1, and, at the same location, a surface impoundment has a value of 2, assign containment a value of 2).

Table 7. Containment Value for Soil/Bedrock or Ground Water Pathways

Assign containment a value of 0 if: (1) All the wastes at the site are underlain by an essentially non permeable surface (natural or artificial) and adequate leachate collection systems and diversion systems are present; or (2) there is no ground water in the vicinity. The value "0" does not indicate no risk. Rather, it indicates a significantly lower relative risk when compared with more serious sites on a state level. Otherwise, evaluate the containment for each of the different means of storage or disposal at the site, using the following guidance.

| Surface Impoundment | Assigned Value |
|---|---|
| Sound run-on diversion structure, essentially non permeable liner (natural or artificial) compatible with the waste, and adequate leachate collection system. | 0 |
| Essentially non permeable compatible liner with no leachate collection system; or inadequate freeboard. | 1 |
| Potentially unsound run-on diversion structure; or moderately permeable compatible liner. | 2 |
| Unsound run-on diversion structure; no liner; or incompatible liner. | 3 |

Containers

| | |
|---|---|
| Containers sealed and in sound condition, adequate liner, and adequate leachate collection system. | 0 |
| Containers sealed and in sound condition, no liner or moderately permeable liner. | 1 |
| Containers leaking, moderately permeable liner. | 2 |
| Containers leaking and no liner or incompatible liner. | 3 |

Piles

| | |
|---|---|
| Piles uncovered and waste stabilized; or piles covered, waste stabilized, and essentially non permeable liner. | 0 |
| Piles uncovered, waste unstabilized, moderately permeable liner, and leachate collection system. | 1 |
| Piles uncovered, waste unstabilized, moderately permeable liner, and no leachate collection system. | 2 |
| Piles uncovered, waste unstabilized, and no liner. | 3 |

Landfill

| | |
|---|---|
| Essentially non permeable liner, liner compatible with waste, and adequate leachate collection system. | 0 |
| Essentially non permeable compatible liner, no leachate collection system, and landfill surface precludes ponding. | 1 |
| Moderately permeable, compatible liner, and landfill surface precludes ponding. | 2 |
| No liner or incompatible liner, moderately permeable compatible liner, landfill surface encourages ponding, no run-on control. | 3 |

Table 8. Containment Values for Surface Water Pathway.

Assign containment a value of 0 if: (1) All the waste at the site is surrounded by diversion structures that are in sound condition and adequate to contain all runoff, spills, or leaks from the waste; or (2) intervening terrain precludes runoff from entering surface water. Otherwise, evaluate the containment for each of the different means of storage disposal at the site and assign a value using the following guidance.

| | Assigned Value |
|---|---|
| Surface Impoundment | |
| Sound diking or diversion structure, adequate freeboard, and no erosion evident. | 0 |
| Sound diking or diversion structure, but inadequate freeboard. | 1 |
| Diking not leaking, but potentially unsound. | 2 |
| Diking unsound, leaking, or in danger of collapse. | 3 |
| Containers | |
| Containers sealed, in sound condition, and surface surrounded by sound diversion or containment system. | 0 |
| Containers sealed and in sound condition, but not surrounded by sound diversion or containment system. | 1 |
| Containers leaking and diversion or containment structures potentially unsound. | 2 |
| Containers leaking, and no diversion or containment structures or diversion structures leaking or in danger of collapse. | 3 |
| Waste Piles | |
| Piles are covered and surrounded by sound diversion or containment system. | 0 |
| Piles covered, wastes unconsolidated, diversion or containment system not adequate. | 1 |
| Piles not covered, wastes unconsolidated, and diversion or containment system potentially unsound. | 2 |
| Piles not covered, wastes unconsolidated, and no diversion or containment or diversion system leaking or in danger of collapse. | 3 |
| Landfill | |
| Landfill slope precludes runoff, landfill surrounded by sound diversion system, or landfill has adequate cover material. | 0 |
| Landfill not adequately covered and diversion system sound. | 1 |
| Landfill not covered and diversion system potentially sound. | 2 |
| Landfill not covered and no diversion system present, or diversion system unsound. | 3 |

## SOIL/BEDROCK PATHWAY ($S_S$)

### A. Waste

Transfer waste score ($S_w$) from waste score sheet.

### B. Current Conditions at the Site

Additional risk exists through direct contact if surficial and/or sub-surface soil is currently impacted at the site. Contamination in the surficial soils poses more of a risk through direct contact then contamination in the sub-surface soils. In addition, contamination in the sub-surface soils or unsaturated zone is considered in the ground water pathway. Assign a value from Table 9.

Table 9. Current Conditions at the Site

| Condition | Assigned Value |
|---|---|
| Known Surficial Soil Contamination | 30 |
| Suspected/Unknown Surficial Soil Contamination | 20 |
| Known Subsurface Soil Contamination | 10 |

### C. Medium Characteristics

*Permeability of surficial soil* is a qualitative indication of the migration potential of a contaminant from a site. Impermeable media tend to retard or impede movement through the medium while permeable media speed up the movement. Contamination that is retarded at the surface may pose a higher risk to human health and/or the environment through direct contact of contamination. Assign a value from Table 10.

Table 10. Permeability of Geologic Materials[1]

| Type of Material | Approximate range of hydraulic conductivity | Assigned Value |
|---|---|---|
| Gravel, sand; karst limestone and dolomite. | $>10^{-3}$ cm/sec | 2 |
| Fine sand and silty sand; sandy loams; loamy sands; moderately permeable limestone, dolomite, and sandstone (no karst); some coarse till. | $<10^{-3}>10^{-5}$ cm/sec | 4 |
| Silt, loess, silty clays, silty | $<10^{-5}>10^{-7}$ cm/sec | 6 |

[1] Derived from: Davis, S. N., *Porosity and Permeability of Natural Materials in Flow-Through Porous Media*, R.J.M. DeWest ed., Academic Press, New York, 1969; Freeze, R.A. and J.A. Cherry, *Groundwater*, Prentice-Hall, Inc., New York, 1979.

| | | |
|---|---|---|
| loams, clay loams; less permeable limestone, dolomite, and sand-stone; moderately permeable till. | | |
| Clay, compact till, shale; | $<10^{-7}$ cm/sec | 8 |

## D. Primary Target Population

The *population* to be counted includes those residing within the 200 ft. radius of the site as well as people regularly in the vicinity such as workers in factories, offices or students. It does not include travelers passing through the area.

Table 11. Primary Target Population

| Resident/Worker Population within 200 feet of site | Assigned Value |
|---|---|
| 0 | 2 |
| 1 - 100 | 4 |
| 101 - 1,000 | 6 |
| 1,001 - 10,000 | 8 |
| > 10,000 | 10 |

## E. Secondary Target Population

*Population* within the 2,000 ft. radius is a rough indicator of the population that could be involved in direct contact incidents at an uncontrolled site.

Table 12. Secondary Target Population

| Resident Population Within 2,000 Feet of Site | Assigned Value |
|---|---|
| 0 | 1 |
| 1 - 1,000 | 2 |
| 1,001 - 10,000 | 3 |
| > 10,000 | 5 |

## F. Accessibility of Site

*Accessibility to waste* refers to the measures taken to limit access by humans or animals to waste. Assign a value using the following guidance.

Table 13. Accessibility of Site

| Accessability | Assigned Value |
|---|---|
| Site is Totally Unaccessable (e.g., television monitoring or surveillance by guards or facility personnel) which continuously monitors and controls entry onto the site; or an artificial or natural barrier (e.g., a fence combined with a cliff), which completely surrounds the site; and a means to control entry, at all times through the gates or other entrances to the site (e.g., an attendant, television monitors, locked entrances, or controlled roadway access to the site). | 1 |
| Site is Semi-Accessable (e.g. security guard, but no barrier). | 3 |
| Site is Fully Accessable | 5 |

## G. Land Use Proximal to Site

*Land use* indicates the nature and level of human activity in the vicinity of a site.

Table 14. Land Use Proximal to Site

| Land Use | Assigned Value |
|---|---|
| Not currently used | 1 |
| Commercial, or Industrial | 2 |
| Cropland, Grazing Land or Agricultrual | 3 |
| Recreation | 4 |
| Residential | 5 |

## GROUND WATER PATHWAY ($S_{GW}$)

### A. Waste

Transfer waste score ($S_W$) from waste score sheet.

### B. Current Conditions at the Site

A default value is assigned if there is known ground water contamination. If no known contamination currently exists then categories are scored to evaluate the potential for ground water contamination to impact human health and/or the environment. Assign a value from Table 9.

Table 15. Current Conditions at the Site

| Condition | Assigned Value |
|---|---|
| Known Ground Water Contamination (use default of 15 and proceed to E). | 15 |
| Ground Water Contamination Unknown (do not score and proceed to C). | |

### C. Permeability of Unsaturated Zone

*Permeability of unsaturated zone* (or intervening geological formations) is a qualitative indication of the migration potential and rate of migration of the contaminant from a site. Impermeable media tend to retard or impede movement through the medium while permeable media speed up the movement. Assign a value from Table 16.

Table 16. Permeability of Geologic Materials[2]

| Type of Material | Approximate range of hydraulic conductivity | Assigned Value |
|---|---|---|
| Clay, compact till, shale | $<10^{-7}$ cm/sec | 2 |
| Silt, loess, silty clays, silty loams, clay loams; less permeable limestone, dolomites, and sand-stone; moderately permeable till. | $<10^{-5}>10^{-7}$ cm/sec | 4 |
| Fine sand and silty sand; sandy laoms; loamy sands; moderately permeable limestone, dolomites, and sandstone (no karst; some coarse till. | $<10^{-3}>10^{-5}$ cm/sec | 7 |
| Gravel, sand, karst limestone and dolomite. | $<10^{-3}$ cm/sec | 10 |

[2] Derived from: Davis, S. N., *Porosity and Permeability of Natural Materials in Flow-Through Porous Media*, R.J.M. DeWest ed., Academic Press, New York, 1969; Freeze, R.A. and J.A. Cherry, *Groundwater*, Prentice-Hall, Inc., New York, 1979.

## D. Depth To Aquifer

*Depth to aquifer of concern* is measured vertically from the lowest point of the waste to the highest seasonal level of the saturated zone of the aquifer of concern. This factor is one indicator of the ease with which a pollutant from the site could migrate to ground water. Assign a value using the following guidance.

Table 17. Depth to Aquifer

| Distance (feet) | Assigned Value |
|---|---|
| >100 feet | 2 |
| 41 - 100 feet | 3 |
| 40 feet or less | 5 |

## E. Yield of Aquifer

*Aquifer yield* can be defined as the maximum rate of water withdrawal that can be sustained by an aquifer without causing an unacceptable decline in the hydraulic head in the aquifer. High-production wells that exceed the maximum rate of withdrawal will influence ground water flow gradients by speeding the movement of contaminants through the aquifer thus increasing the likelihood of exposure. Assign a value using the following guidance.

Table 18. Yield of Aquifer

| Yield | Assigned Value |
|---|---|
| Extremely low yield | 1 |
| < 25 gpm | 2 |
| 25-100 gpm | 4 |
| > 100 gpm | 5 |

## F. Ground Water Use

*Ground water use* indicates the nature of the use made of ground water drawn from the aquifer of concern within three (3) miles of the contamination, including the geographical extent of the measurable concentration in the aquifer. Assign a value using the following guidance.

Table 19. Ground Water Use.

| Ground Water Use | Assigned Value |
|---|---|
| Unusable (e.g., extremely saline aquifer, extremely low yield, etc.) | 1 |
| Non-Drinking Water Source (e.g., irrigation, industrial, ect.) | 6 |
| Drinking Water Source with alternate unthreatened water supply sources available | 10 |
| Drinking Water Source with no other alternate water supply sources available | 16 |

## G. Type of Water Well Impacted by Contaminant/Targets

The *type of water well* that has been contaminated is an indicator of the number of individuals of a population which may be impacted by the contamination. A public water supply well will impact many more people than a private well which serves only one family. Assign a value using the following guidance.

Table 20. Type of Water Well Impacted by Contaminant/Targets

| Type of Well | Assigned Value |
|---|---|
| No Known Well Impacted | 1 |
| Non-Drinking Water Well Impacted | 4 |
| Drinking Water Well Impacted (refer to target population) | |
| Target Population 1-24 | 8 |
| Target Population 25-100 | 10 |
| Target Population 101-1,000 | 12 |
| Target Population > 1,000 | 14 |

## H. Distance to Nearest Uncontaminated Drinking Water Well

*Distance to nearest uncontaminated well* is measured from the known contamination to the site to the nearest well that draws water from the aquifer of concern. If the actual distance to the nearest well is unknown, use the distance between the known contamination and the nearest occupied building not served by a public water supply (e.g., a farmhouse).

Table 21. Distance to Nearest Uncontaminated Drinking Water Well

| Distance | Assigned Value |
|---|---|
| > 3 miles | 1 |
| 2 to 3 miles | 4 |
| 1 to 2 miles | 8 |
| 1/2 mile to 1 mile | 12 |
| < 1/2 mile | 16 |

## SURFACE WATER PATHWAY ($S_{SW}$)

### A. Waste

Transfer waste score ($S_W$) from waste score sheet.

### B. Current Conditions at the Site

A default value is assigned if there is known surface water contamination. If no known contamination currently exists then categories are scored to evaluate the potential for surface water contamination to impact human health and/or the environment. Assign a value from Table 9.

Table 22. Current Conditions at the Site

| Condition | Assigned Value |
|---|---|
| Known Surface Water Contamination (use default of 20 and proceed to E). | 20 |
| Surface Water Contamination Unknown (do not score and proceed to C). | |

### C. Distance to Nearest Surface Water

*Distance to the nearest surface water* is the shortest distance from the known contamination, (not the site or property boundary) to the nearest downhill body of surface water (e.g., lake or stream) that is on the course that runoff can be expected to follow and that at least occasionally contains water. Do not include man-made ditches which do not connect with other surface water bodies. In areas having less than 20 inches of normal annual precipitation, consider intermittent streams. This factor indicates the potential for pollutants flowing overland and into surface water bodies. Assign a value using the following guidance.

Table 23. Distance to Nearest Surface Water

| Distance | Assigned Value |
|---|---|
| > 2 miles | 2 |
| 1 to 2 miles | 4 |
| 1,000 feet to 1 mile | 7 |
| < 1,000 feet | 10 |

## D. Potential Flood Condition

Floodplains are delineated on the basis of statistical analysis of long-term records of stream flow. The Federal Emergency Management Agency (FEMA) publishes "Flood Insurance Rate Maps." FEMA Flood Insurance Rate Maps delineate 100-year and 500-year floodplains. Local planning commissions and similar authorities may have maps which delineate annual and 10-year floodplains. Assign a value to the probability that the site will be flooded using the following guidance.

Table 24. Potential Flood Condition

| Potential Flood Condition | Assigned Value |
|---|---|
| Site outside 500-year floodplain | 2 |
| Site in 500-year floodplain | 4 |
| Site in 100-year floodplain | 7 |
| Site in annual or 10-year floodplain | 10 |

## E. Surface Water Use

*Surface water use* brings into the rating process the use being made of surface water downstream from the site. The use or uses of interest are those associated with water taken from surface waters within a distance of three miles from the location of the known contamination. Assign a value as follows.

Table 25. Surface Water Use

| Surface Water Use | Assigned Value |
|---|---|
| Unusable (e.g., extremely saline aquifer, extremely low yield, etc.) | 1 |
| Non-Drinking Water Source (e.g., irrigation, industrial, ect.) | 8 |
| Drinking Water Source with alternate unthreatened water supply sources available | 16 |
| Drinking Water Source with no other alternate water supply sources available | 25 |

F. Population Served/Water Intake Within Three (3) Miles

*Population served by surface water with water intake within 3 miles downstream from site* (or 1 mile in static surface water such as a lake) is a rough indicator of the potential hazard exposure of the nearby population served by potentially contaminated surface water. Measure the distance from the probable point of entry to surface water following the surface water (stream miles). The population includes residents as well as others who would regularly use the water such as workers in factories or offices and students. Include employees in restaurants, motels, or campgrounds but exclude customers and travelers passing through the area in autos, buses and trains. The distance is measured from the known contamination, including observations in stream or sediment samples, regardless of site boundaries. Where only residential houses can be counted (e.g., from an aerial photograph), and residents are known to be using surface water, assume 3.8 individuals per dwelling unit. Where surface water is used for irrigation, convert to population by assuming 1.5 persons per acre of land irrigated. Assign a value as follows.

Table 25. Population Served/Water Intake Within 3 Miles Downstream

| Type of Intake | Assigned Value |
|---|---|
| No Known Surface Water Intake Impacted | 1 |
| Non-Drinking Surface Water Intake Impacted | 6 |
| Drinking Water - Surface Water Intake Impacted (refer to target population) | |
| Target Population 1-24 | 10 |
| Target Population 25-100 | 12 |
| Target Population 101-1,000 | 18 |
| Target Population > 1,000 | 25 |

## AIR PATHWAY ($S_A$)

At the Project Managers discretion, an air sample will be collected and analyzed for chemcials of concern. Data will be submitted to the Bureau of Air. If contaminant levels in air are of concern, use ranking below, otherwise do not score.

A. Waste

Transfer waste score ($S_W$) from waste score sheet.

B. Population Within 1-Mile Radius

*Population within a one-mile radius* is an indicator of the population which may be harmed should contamination be released to the air. The distance is measured from the location of the known contamination, not from the site boundary. The population to be counted includes persons residing within the one-mile radius as well as transients such as workers in factories, offices, restaurants, motels, or students. It excludes travelers passing through the area. If aerial photography is used in making the count, assume 3.8 individuals per dwelling unit. Select the highest value for this rating factor as follows.

Table 26. Population Within 1-Mile Radius

| Population | Assigned Value |
|---|---|
| Rural - Sparse (1 - 100) | 1 |
| Suburban - Single-family (101 - 1,000) | 12 |
| Urban - Moderately Dense (1,001 - 10,000) | 24 |
| Central Business District - Dense (>10,000) | 35 |

## C. Sensitive Targets

*Sensitive targets* includes schools, parks, lakes, other recreational areas, critical habitats, ect. that could be impacted from an air release. Assign a value from Table 27.

Table 27. Land Use Within 1/2 Mile.

| Land Use | Assigned Value |
|---|---|
| No Known Sensitive Targets | 5 |
| Known Sensitive Targets Within 1/2 Mile | 15 |
| Known Sensitive Targets Within 1/4 Mile | 25 |
| Known Sensitive Targets Adjacent To Site | 35 |